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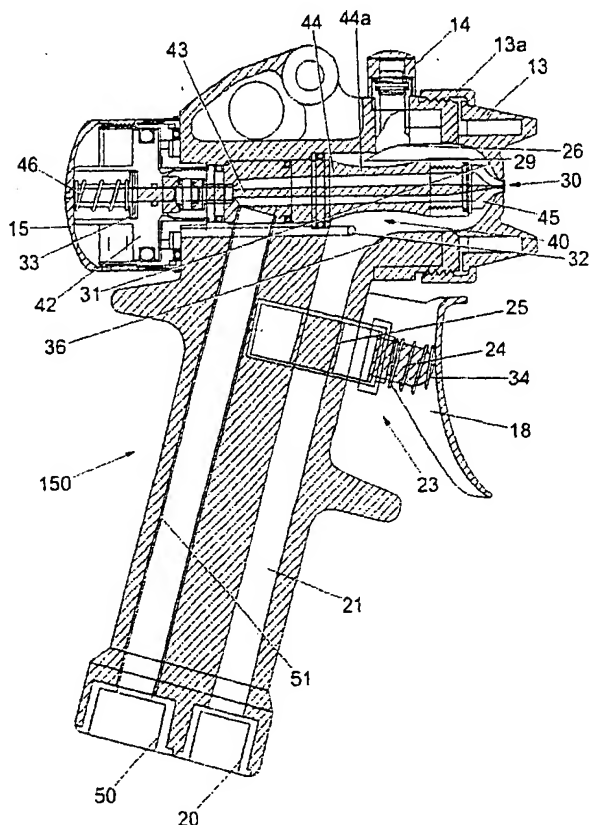
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(54) Title: **SPRAY GUN**



(57) Abstract: A spraying apparatus (10) for spraying liquid surface treatment material comprises a gas inlet (20), a liquid inlet (50) and an outlet nozzle (30). The apparatus (10) also comprises a needle valve (40) for regulating the supply of surface treatment material to the nozzle (30). The needle valve (40) is at least partially located within a gas outlet chamber (26) and is adapted so as to cause minimal disruption to the gas flow from the gas inlet (20) to the nozzle (30). To further aid gas flow efficiency, the gas supply passage (21) is substantially straight, the outlet chamber (26) has a laterally outwardly tapering inlet and an inwardly tapering outlet (270, 31) and a smooth radius of curvature (29) from the gas supply passage (21) into the outlet chamber (26). There is also provided a control means for controlling the axial movement of the needle valve (40), the control means being provided with indicator means so as to provide an accurate, repeatable control means.

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SPRAY GUN

1 The present invention relates to an apparatus to
2 improve efficiency in the spraying of materials.
3 Particularly, but not exclusively, the invention is
4 a spray gun for the application of paint and similar
5 material surface treatments, particularly water-
6 based paints.

7
8 Various known spray guns have been developed for the
9 purpose of reducing pressure losses between the air
10 inlet and air outlet of guns. Conventional spray
11 guns, high volume-low pressure (HVLP) guns and low
12 volume-low pressure (LVLP) guns all suffer from a
13 reduction in air pressure through the gun. In some
14 instances, this reduction can be over 80%.

15
16 HVLP guns require very large volumes of air to
17 maintain an acceptable atomization of the spray
18 material. For example, to pass large volumes of air
19 through an HVLP gun requires very high pressures to
20 maintain a 10psi (0.69bar) pressure in the head of

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1 the gun, resulting in an average air consumption
2 rate of approximately 20scfm (566 l/min). With an
3 input pressure of 75psi (5.1bar), the air expands on
4 leaving the gun to regain its pre-compression
5 volume. This will result in the atomized spray
6 material being taken in all directions by the
7 expanding air, in spite of the exit pressure being
8 only 10psi (0.69bar). Thus, the spray output of
9 HVLP guns can prove difficult to control.

10

11 Despite having a smaller clearance between the fluid
12 tip and air cap than in HVLP guns, LVLP guns also
13 suffer from pressure loss within the gun body. As a
14 result, LVLP guns still require a high inlet
15 pressure of 50-60psi (3.45-4.14bar) to operate at an
16 atomizing (outlet) pressure of 15-18psi (1.03-
17 1.24bar). Air consumption rates of LVLP guns range
18 from 14-18scfm (396-510 l/min), thus illustrating
19 that LVLP guns are almost as inefficient as HVLP
20 guns.

21

22 The main cause of the aforementioned inefficiency of
23 HVLP and LVLP guns is the arrangement of the air
24 passages within the gun body. The design and layout
25 of air passages in the known guns leads to poor
26 internal air flow efficiency.

27

28 It is therefore the aim of the present invention to
29 provide a spraying apparatus which has a
30 significantly improved air flow efficiency over
31 known spray guns.

32

1 According to a first aspect of the present
2 invention, there is provided an apparatus for
3 spraying liquid surface treatment material, the
4 apparatus comprising:

5 a liquid inlet for supply of the liquid surface
6 treatment material;

7 a gas inlet for supply of pressurized gas to be
8 mixed with the liquid surface treatment material;

9 an outlet nozzle through which the gas and
10 liquid surface treatment is sprayed;

11 a control needle valve arranged for axial
12 movement on a first axis and adapted to regulate the
13 supply of the liquid surface treatment material to
14 the outlet nozzle;

15 a gas valve operable between an open position
16 and a closed position;

17 a gas chamber communicating with said outlet
18 nozzle and arranged to co-axially surround the
19 control needle valve; and

20 a gas supply passageway having first and second
21 portions with first and second diameters,
22 respectively, the first portion connecting said gas
23 inlet and said gas valve and the second portion
24 connecting said gas valve and said gas chamber;

25 wherein the first and second portions of the
26 gas supply passageway are coaxial and the first and
27 second diameters are substantially equal such that
28 the gas supply passageway has substantially the same
29 diameter over its entire length.

30

31 Preferably, the gas chamber has a first end portion
32 adjacent the gas supply passageway, the first end

1 portion having a radius of curvature so as to
2 provide gas to the nozzle in a direction
3 substantially parallel to said first axis, and
4 wherein said apparatus is adapted to provide a
5 smooth flow path for the gas therethrough. The
6 radius of curvature is such that the minimum radius
7 of the internal surface of the first end portion of
8 the gas chamber is 1.3 times the diameter of the gas
9 supply passageway.

10

11 Preferably, the gas chamber has an inner surface
12 which tapers laterally outwardly from the first end
13 portion of the gas chamber, the taper running in the
14 direction of said outlet nozzle.

15

16 Preferably, the gas chamber includes a second end
17 portion adjacent said outlet nozzle, the inner
18 surface of said second end portion inwardly tapering
19 towards said nozzle to provide a smooth flow path
20 for gas flowing from the outlet chamber to the
21 nozzle.

22

23 Preferably, said gas valve is located within said
24 gas supply passageway. Preferably, said gas valve
25 is an axially-sliding piston valve having an
26 aperture therein whose diameter is substantially
27 equal to the diameter of the gas supply passageway.

28

29 Preferably, said apparatus further comprises a
30 trigger means adapted to operate both said control
31 valve and said gas valve.

32

1 Preferably, said control needle valve is partially
2 located within said gas chamber and includes a fluid
3 tube having a fluid tube diameter and a fluid tip
4 having a fluid tip diameter substantially equal to
5 or less than the fluid tube diameter. Preferably,
6 said fluid tube has a tapered throat portion located
7 in said gas chamber, the throat portion having a
8 throat portion diameter which is less than the fluid
9 tube diameter.

10

11 According to a second aspect of the present
12 invention, there is provided an apparatus for
13 spraying liquid surface treatment material, the
14 apparatus comprising:

15 a housing;

16 a liquid inlet for supply of the liquid surface
17 treatment material;

18 a gas inlet for supply of pressurized gas to be
19 mixed with the liquid surface treatment material;

20 an outlet nozzle through which the gas and
21 liquid surface treatment is sprayed;

22 a control needle valve adapted to regulate the
23 supply of the liquid surface treatment material to
24 the outlet nozzle;

25 a gas supply passageway connecting said gas
26 inlet to said outlet nozzle; and

27 a control means for controlling the control
28 needle valve, the control means comprising a cap
29 member received on said housing and engaged with
30 said control needle valve, the cap member being
31 adapted so as to be adjustable in the axial

1 direction relative to the housing to limit axial
2 movement of the control needle valve.

3
4 Preferably, said cap member and housing are provided
5 with calibrations which indicate the amount of axial
6 adjustment of the needle valve.

7
8 Preferably, the apparatus further comprises a gas
9 valve operable between an open position and a closed
10 position.

11
12 In a preferred embodiment, the gas valve is located
13 in the gas supply passageway and the apparatus
14 further comprises a trigger means adapted to operate
15 both said control needle valve and gas valve.

16
17 In an alternative preferred embodiment, said control
18 needle valve and gas valve are remotely operated.
19 Most preferably, the control needle valve is
20 remotely operated by way of pressurised gas and the
21 apparatus further comprises a piston chamber and a
22 piston located in the piston chamber, the piston
23 adapted to engage said needle control valve when
24 actuated by said pressurised gas. The apparatus
25 also comprises a bore connecting the gas supply
26 passageway and the piston chamber, such that
27 pressurised gas may pass through the bore to the
28 piston chamber when the gas valve is in the open
29 position.

30

1 Embodiments of the present invention will now be
2 described, by way of example only, with reference to
3 the accompanying drawings, in which:

4

5 Figure 1 shows a side elevation view of a first
6 embodiment of a spray apparatus;

7 Figure 2 shows a longitudinal cross-section of
8 the first embodiment of the spray apparatus shown in
9 Figure 1;

10 Figure 3 shows a longitudinal cross-section of
11 a second embodiment of the spray apparatus;

12 Figure 4 shows a longitudinal cross-section of
13 a third embodiment of the spray apparatus;

14 Figures 5(a) and 5(b) show plan and side
15 elevation views, respectively, of a fourth
16 embodiment of the spray apparatus;

17 Figure 6 shows a cross-section through the
18 fourth embodiment of the spray apparatus, taken
19 along line VI-VI of Figure 5(a);

20 Figure 7 shows a cross-section through the
21 fourth embodiment of the spray apparatus, taken
22 along line VII-VII of Figure 5(b);

23 Figure 8(a) shows a side elevation of a fifth
24 embodiment of the spray apparatus; and

25 Figure 8(b) shows a longitudinal cross-section
26 through the fifth embodiment shown in Figure 8(a).

27

28 Referring initially to Figure 1, there is shown a
29 first embodiment of a spraying apparatus, or spray
30 gun, generally designated 10. The spray gun 10
31 includes a housing 11 having a fluid control sleeve
32 12 slidably attached thereto, an air cap 13 which

1 is held on the housing 11 by an air cap ring 13a
2 threadedly received on the housing 11, and a
3 regulating valve 14 for controlling the spray
4 pattern of the gun. Also included on the housing 11
5 is a needle valve cap, or fluid control nut, 15
6 which is attached to an internal needle valve
7 arrangement and is threadedly received on the
8 control sleeve 12 to limit longitudinal adjustment
9 of the needle valve. The needle valve cap 15 is
10 provided with horizontal markings 16 spaced
11 equidistantly about the circumference thereof which,
12 in combination with vertical markings on the housing
13 11, allow the operator to limit the movement of the
14 needle valve and thus the amount of spray material
15 passing through the nozzle. The housing has a
16 horizontal indicator line 17a from which extend a
17 plurality of vertical indicator lines 17b at 1mm
18 intervals. By adjustment of the cap 15, the leading
19 edge of the cap 15 can be adjusted to line up with
20 any of the vertical indicator lines 17b on the
21 housing. In this embodiment, there are ten
22 horizontal markings 16 on the cap 15 at equidistant
23 intervals. Adjustment of the cap 15 can be made
24 such that one of the horizontal markings 16 of the
25 cap 15 can line up with the horizontal indicator
26 line 17a of the housing. Thus, if one horizontal
27 marking 16 of the cap is aligned with the horizontal
28 line 17a of the housing, a 36 degree rotation of the
29 cap will line up the subsequent horizontal marking
30 of the cap 15. This procedure will be explained in
31 more detail below.

1 The embodiment shown in Figure 1 is a manual spray
2 gun having a handle or grip portion 19. The gun 10
3 has a trigger 18 that operates a gas control valve
4 (not shown in Figure 1) and also acts upon the fluid
5 control sleeve 12, such that fluid and gas are
6 introduced to the gun simultaneously.

7
8 The operation of the first embodiment of the spray
9 gun 10 will now be described with reference to
10 Figure 2. Gas is provided to the gun 10 by way of a
11 gas inlet 20 and is then passed through a straight
12 communicating passageway 21 to the gas control valve
13 23 and on to a gas chamber 26. The communicating
14 passageway 21 has a first portion which connects the
15 gas inlet 20 and the gas control valve 23, and a
16 second portion which connects the gas control valve
17 23 to the gas chamber 26. Both portions of the
18 passageway 21 are arranged co-axially such that the
19 entire passageway is substantially straight. In
20 addition, the diameters of the first and second
21 portions are substantially the same such that there
22 is no narrowing or widening of the passageway until
23 it meets the gas chamber 26.

24
25 The gas control valve 23 is positioned perpendicular
26 to the gas flow and comprises an axially-sliding
27 piston 24 which is acted upon by the trigger 18.
28 The piston 24 is provided with a bore 25 drilled
29 through the piston 24 perpendicular to the
30 longitudinal axis of the piston 24. The bore 25 is
31 the same size as the bore of the communicating
32 passageway 21, so that when the trigger 18 is

1 depressed, the bore 25 aligns with the passageway 21
2 to provide a smooth passage for the gas through the
3 gas control valve 23 without creating turbulence.

4

5 Once through the gas control valve 23 and the second
6 portion of the passageway 21, the gas reaches the
7 gas chamber 26. The gas chamber 26 has a first end
8 portion 29 adjacent the gas passageway 21 which has
9 a radius of curvature sufficient to direct the gas
10 flow into a substantially horizontal direction when
11 viewed in the accompanying figures. Preferably, the
12 inside curve 36 of the first end portion 29 has a
13 radius of curvature which is at least 1.3 times the
14 diameter of the passageway 21.

15

16 As will be described below, the chamber 26 is also
17 laterally tapered to aid gas flow therethrough. At
18 a second end portion of the chamber 26 which is
19 remote from the first end portion 29 is an outlet
20 nozzle 30 through which the combined gas and spray
21 material will exit the gun. The second end portion
22 of the chamber 26 has an inner surface 31 which has
23 a radius of curvature which allows the inner surface
24 31 to taper inwardly to the point where it reaches
25 the output nozzle 30.

26

27 Partially located within the output chamber 26 is a
28 control needle valve, generally designated 40. The
29 control needle valve 40 comprises a fluid needle 43,
30 fluid tube 44 and fluid tip 45. The cap 15 is
31 provided with a needle housing 41 in which the fluid
32 needle 43 is housed. The fluid needle 43 is biased

1 by a needle spring 46 in a closed position. The
2 needle housing 41 enters into a return spring piston
3 42 fitted to the control sleeve 12 by a retaining
4 means such as a circlip, for example. A return
5 spring 47 is also provided to bias the fluid sleeve
6 12 and trigger 18 in the closed position.

7
8 The fluid needle 43 extends forward through the
9 fluid tube 44 to rest in a seat of the fluid tip 45.
10 The needle spring 46 biases the fluid needle 43 such
11 that it sits in the seat at the fluid tip 45,
12 thereby blocking the exit of fluid from the fluid
13 tube 44 to the output nozzle 30. The diameter of
14 the fluid tip 45 is sized so as to be no greater
15 than the diameter of the fluid tube 44, to prevent
16 disruption to the gas flow through the output
17 chamber 26 to the nozzle 30. Furthermore, the
18 embodiment of Figure 2 shows the use of a fluid tube
19 44 which has a narrower throat portion 44a within
20 the output chamber 26. The throat portion 44a has a
21 diameter less than that of the remainder of the
22 fluid tube 44 and can be provided so as to provide a
23 smoother passage for the gas as passes through the
24 gas chamber 26.

25
26 In operation, the trigger 18 may always move the
27 control sleeve 12 its full stroke. However, the cap
28 15 can be rotationally adjusted on the sleeve 12 to
29 restrict or increase the intrusion of the needle
30 housing 41 into the return spring piston 42. In
31 this way, the movement of the fluid needle 43 can be
32 adjusted relative to the full stroke of the sleeve

1 12. Where the cap 15 has been adjusted to restrict
2 movement of the fluid needle 43 entirely, a gap
3 exists between the end of the needle housing 41 and
4 the end of the fluid needle 43 which is equal to the
5 full stroke of the control sleeve 12. Thus, the
6 trigger 18 can be operated and move the sleeve 12 to
7 its full stroke without moving the fluid needle 43
8 away from its seat in the fluid tip 45.

9
10 As previously described with reference to Figure 1,
11 the gun housing has a plurality of vertical
12 indicator lines 17b along a portion of its length at
13 1mm intervals. The cap 15 can be adjusted such that
14 the leading edge of the cap member 15 is aligned
15 with one of the vertical indicator lines 17b. Once
16 aligned, the horizontal markings 16 of the cap 15
17 can be aligned with the horizontal indicator line
18 17a of the housing. Each horizontal marking 16 on
19 the cap 15 represents a reduction or increase in
20 potential fluid needle movement of 0.1mm. In this
21 way, the spray gun is provided with an accurate,
22 repeatable adjustment of the fluid needle 43 in a
23 similar manner to that of a micrometer.

24
25 If cleaning of the fluid needle 43 is required, the
26 cap 15 can simply be unscrewed from the gun housing
27 and detached along with the fluid needle 43.

28
29 The embodiment shown in Figures 1 and 2 is of a
30 manual spray gun in which the spray material is fed
31 in under pressure via a fluid inlet 50. A fluid
32 passage 51 then conveys the spray material through

1 the handle portion 19 of the gun to the fluid tube
2 44.

3
4 The embodiment shown in Figure 3 is also a manual
5 spray gun 100 and it operates in the same manner as
6 the embodiment of Figures 1 and 2. Thus, the same
7 reference signs are used for the shared components
8 and will not be described further here. However,
9 where this second embodiment 100 differs from the
10 first embodiment is that the fluid is fed into the
11 gun from a reservoir under gravity. Thus, fluid
12 inlet 60 is located on the top of the gun 100 in
13 this embodiment, and the fluid reservoir (not shown)
14 may be simply screwed into the inlet 60. The fluid
15 is then passed directly into the fluid tube 44 of
16 the gun for delivery to the fluid tip 45 and nozzle
17 30.

18
19 Figure 5 shows a longitudinal cross-section through
20 a third embodiment 150 of the spray apparatus, which
21 is a further modification of the first embodiment of
22 the apparatus shown in Figures 1 and 2. As with the
23 second embodiment 100, the third embodiment of the
24 gun 150 has many of the features of the first
25 embodiment 10. Those shared features have the same
26 reference numerals in Figure 5 and will not be
27 described further. However, where the third
28 embodiment 150 differs from both the first and
29 second embodiments 10, 100 is that the gun uses
30 pneumatic rather than mechanical operation of the
31 needle valve. As a result, the third embodiment 150
32 does not have a sliding fluid control sleeve on the

1 housing. Instead, the inlet to the chamber 26 is
2 provided with a bore 32 which directs a portion of
3 the pressurised gas in the passageway 21 to act
4 directly upon the piston 42. The needle 43 is
5 adapted with a flange 33 which is located between
6 the needle spring 46 and the piston 42. Thus, as
7 the pressurised gas in the bore 32 acts upon the
8 piston 42, the piston 42 in turn acts upon the
9 needle flange 33, moving the needle 43 away from the
10 seat of the fluid tip 45. As gas is now acting upon
11 the piston 42 directly, O-ring seals are added to
12 the piston 42 itself and at the base of the end cap
13 15 so that there is no loss of pressurised gas
14 during operation.

15

16 The purpose of the third embodiment 150 of the gun
17 is to provide a manual spray gun where the fluid
18 needle is operated without the need for a mechanical
19 action. Once the trigger 18 is pulled and the
20 piston bore 25 aligns with the passageway 21 to
21 allow gas into the chamber 26, gas will enter the
22 bore 32 and act upon the piston 42. However, the
23 end cap 15 operates as previously described to limit
24 the movement of the needle 43 and hence control the
25 amount of fluid released at the nozzle 30. Once the
26 trigger 18 is released, a trigger return spring 34
27 returns the trigger 18 and thus closes the
28 passageway 21. With the gas to the piston 42 cut
29 off, the piston 42 and needle 43 return to the
30 closed position under the action of the return
31 spring 46.

32

1 Figures 5(a) and 5(b) show plan and side elevation
2 views, respectively, of a fourth embodiment of the
3 present invention. The fourth embodiment differs
4 from the previously described embodiments in that it
5 is an automatic spray gun rather than a manual gun.
6 The automatic gun, generally designated 200, shares
7 a number of components with the previous
8 embodiments. The gun comprises a housing 211 upon
9 which an air cap 213 is held by an air cap ring 213a
10 which is threadedly received on the housing 211. In
11 addition, a regulating valve 214 is provided for
12 controlling the spray pattern of the gun 200, and a
13 needle valve cap 215 is also provided in order to
14 limit the longitudinal adjustment of the fluid
15 needle of a needle valve, as described in respect of
16 the first and second embodiments.

17
18 Turning now to Figures 6 and 7, the operation of the
19 automatic gun 200 will be described in more detail.
20 Generally, the atomising gas passes through the gun
21 in the same manner as with the previous embodiments,
22 except that the gas in this instance is supplied by
23 a remote operated valve (not shown), rather than a
24 trigger-operated valve. The gas enters the gun 200
25 at atomising gas inlet 220 and enters output chamber
26 226.

27
28 The chamber 226 has a radius of curvature 229 at its
29 inlet end so that the incoming atomising gas is
30 directed in a horizontal direction through the
31 output chamber 226 towards the output nozzle 230.
32 Furthermore, the portion of the chamber 226 adjacent

1 the nozzle 230 has an inner surface 231 which has a
2 radius of curvature which allows the inner surface
3 231 to taper inwardly to the point where it reaches
4 the output nozzle 230.

5
6 Partially located within the output chamber 226 is a
7 control needle valve, generally designated 240. The
8 control needle valve 240 comprises a fluid tube 244
9 and a fluid tip 245, where a fluid needle 243
10 extends forward through the fluid tube 244 to rest
11 in a seat of the fluid tip 245. A needle spring 246
12 biases the fluid needle 243 such that it sits in the
13 seat at the fluid tip 245, thereby blocking the exit
14 of fluid from the fluid tube 244 to the output
15 nozzle 230. The diameter of the fluid tip 245 is
16 sized so as to be no greater than the diameter of
17 the fluid tube 244, to prevent disruption to the gas
18 flow through the output chamber 226 to the nozzle
19 230. This embodiment again shows the use of a fluid
20 tube 244 which has a narrower throat portion 244a
21 within the output chamber 226. The throat portion
22 244a can be provided so as to provide a smoother
23 passage for the gas as it leaves the gas inlet 220
24 and enters the chamber 226.

25
26 As this embodiment of the invention is an automatic
27 gun, the trigger, control sleeve, needle housing and
28 return spring piston necessary in the manual gun are
29 replaced by an operating piston 250 which is housed
30 within a piston housing 252 threadedly attached to
31 the main housing 211 of the gun. The cap 215
32 operates in the same manner as described above for

1 the previous embodiments so as to restrict the
2 movement of the fluid needle 243 to regulate fluid
3 flow. The markings and indicator lines described in
4 respect of the first and second embodiments may also
5 be used in respect of the automatic gun so that the
6 micrometer-style adjustment of the spray may be
7 achieved. The only difference is that the indicator
8 lines are provided on a lock nut 251 which prevents
9 accidental adjustment of the cap 215. As with the
10 previous embodiments, the fluid needle 243 may be
11 withdrawn from the gun completely for cleaning, as
12 the cap 215 has an internal flange (not shown) which
13 picks up the end of the needle 243 adjacent the cap
14 215.

15

16 The piston 250 is operated by pressurised gas
17 entering the piston housing 252 from a piston gas
18 inlet 253. As with the atomising gas, the piston
19 gas is controlled by a valve means remote from the
20 gun itself. As the piston gas enters the piston
21 housing 252, the gas pushes the piston 250 back and
22 into contact with a flange 254 on the needle 243.
23 Therefore, as the piston 250 moves back, the needle
24 243 also moves back, thus opening the fluid tip 245
25 to spray material located in the fluid tube 244
26 which has entered the fluid tube 244 via a fluid
27 inlet 260. An abutment (not shown) on the inside of
28 the cap 215 then comes into contact with the needle
29 243, thus restricting movement of the needle 243.
30 Therefore, if the cap 215 is screwed clockwise onto
31 the housing it will lessen the amount of movement
32 possible by the needle, and if it is screwed anti-

1 clockwise it will increase the amount of needle
2 movement. Hence, fluid flow in the gun is
3 controlled by the adjustment of the cap 215.

4

5 Figure 7 shows a cross-section of the embodiment of
6 Figures 5 and 6, but along section line VII-VII.
7 The main purpose of this cross-section is to
8 illustrate the lateral taper of the output chamber
9 226, which can be included in any of the previously
10 described embodiments. As can be seen in Figure 7,
11 the inner surface 270 of the chamber 226 tapers
12 laterally outwardly from inlet to outlet. This
13 taper again aids the smooth flow of gas through the
14 gun.

15

16 Figures 8(a) and (b) show a fifth embodiment of the
17 spray apparatus, which is an adaptation of the
18 fourth embodiment of the apparatus. The fifth
19 embodiment shares the majority of the features of
20 the fourth embodiment and these will not be
21 described further here, but are shown with the same
22 reference numerals in Figures 8(a) and (b). Where
23 the fifth and fourth embodiments differ is that the
24 end cap 215 in the fifth embodiment has been adapted
25 so as to provide fine adjustment of the movement of
26 the needle valve 243. The only differences visible
27 from outside the apparatus, as shown in Figure 8(a),
28 are that the end cap 215 now fits over the end of
29 the piston housing 252 and is provided with
30 calibrations 216. The calibrations 216 are viewed
31 against a reference line 217 on the piston housing
32 252.

1
2 Figure 8(b) shows the adaptations to the end cap 215
3 in more detail. It can be seen that the end cap 215
4 has internal threads 270 which co-operate with
5 external threads 272 on the outside of the piston
6 housing 252. With the calibrations 216 on the end
7 cap 215, the operator can easily adjust the
8 permitted movement of the needle 243 to obtain a
9 previous setting. Thus, there is no longer a need
10 for the lock nut of the previous embodiment.
11 Otherwise, the fifth embodiment operates in the same
12 way as the fourth embodiment.

13
14 An advantage of the present invention over existing
15 spray apparatus is that pressure loss across the gun
16 from gas inlet to the nozzle is reduced thanks to
17 the efficient flow of gas through the gun. In the
18 manual embodiment, the gas passageway is
19 substantially straight and the control valve bore is
20 the same size as that of the passageway so that the
21 flow of gas is uninhibited when the control valve is
22 open. In both the manual and automatic embodiments
23 the inlet to the output chamber has an increased
24 diameter to allow a gradual curve of the gas flow
25 into a substantially horizontal direction through
26 the chamber. Furthermore, with the lateral taper of
27 the chamber wall and the inward taper adjacent the
28 output nozzle, gas flow through the chamber is
29 smooth. The gas flow is further aided as the
30 diameter of the fluid tip of the needle valve does
31 not protrude outwith the diameter of the fluid tube

1 and the fluid tube has a tapered throat section in
2 the output chamber.

3

4 A further advantage of the present invention is that
5 by providing the cap markings and indicator lines on
6 the gun housing, the operator of the gun may adjust
7 the spray of the gun to an exact setting previously
8 used. This repeatability means that there no longer
9 a need for the operator to waste valuable time
10 experimenting to retrieve a previously used spray
11 ratio.

12

13 A possible modification to the present invention
14 would be to incorporate a radioactive ionising
15 source such as a radioactive ionising cartridge, for
16 example, into the atomising gas inlet. Introducing
17 such a source would ionise the atomising gas and
18 would overcome problems associated with static
19 charge build up on atomised spray droplets.

20

21 This and other modifications and improvements can be
22 incorporated without departing from the scope of the
23 invention.

CLAIMS:

- 1 1. An apparatus for spraying liquid surface
2 treatment material, the apparatus comprising:
3 a liquid inlet for supply of the liquid surface
4 treatment material;
5 a gas inlet for supply of pressurized gas to be
6 mixed with the liquid surface treatment material;
7 an outlet nozzle through which the gas and
8 liquid surface treatment is sprayed;
9 a control needle valve arranged for axial
10 movement on a first axis and adapted to regulate the
11 supply of the liquid surface treatment material to
12 the outlet nozzle;
13 a gas valve operable between an open position
14 and a closed position;
15 a gas chamber communicating with said outlet
16 nozzle and arranged to co-axially surround the
17 control needle valve; and
18 a gas supply passageway having first and second
19 portions with first and second diameters,
20 respectively, the first portion connecting said gas
21 inlet and said gas valve and the second portion
22 connecting said gas valve and said gas chamber;
23 wherein the first and second portions of the
24 gas supply passageway are coaxial and the first and
25 second diameters are substantially equal such that
26 the gas supply passageway has substantially the same
27 diameter over its entire length.
28
29 2. The apparatus of Claim 1, wherein said gas
30 chamber has a first end portion adjacent the gas

1 supply passageway, the first end portion having a
2 radius of curvature so as to provide gas to the
3 nozzle in a direction substantially parallel to said
4 first axis, and wherein said apparatus is adapted to
5 provide a smooth flow path for the gas therethrough.

6

7 3. The apparatus of Claim 2, wherein said radius
8 of curvature is such that the minimum radius of the
9 internal surface of the first end portion of the gas
10 chamber is 1.3 times the diameter of the gas supply
11 passageway.

12

13 4. The apparatus of either Claim 2 or Claim 3,
14 wherein the gas chamber has an inner surface which
15 tapers laterally outwardly from the first end
16 portion of the gas chamber, the taper running in the
17 direction of said outlet nozzle.

18

19 5. The apparatus of any of Claims 2 to 4, wherein
20 said gas chamber includes a second end portion
21 adjacent said outlet nozzle, the inner surface of
22 said second end portion inwardly tapering towards
23 said nozzle to provide a smooth flow path for gas
24 flowing from the outlet chamber to the nozzle.

25

26 6. The apparatus of any preceding claim, wherein
27 said gas valve is located within said gas supply
28 passageway.

29

30 7. The apparatus of any preceding claim, wherein
31 said gas valve is an axially-sliding piston valve
32 having an aperture therein whose diameter is

1 substantially equal to the diameter of the gas
2 supply passageway.

3

4 8. The apparatus of any preceding claim, wherein
5 said apparatus further comprises a trigger means
6 adapted to operate both said control valve and said
7 gas valve.

8

9 9. The apparatus of any preceding claim, wherein
10 said control needle valve is partially located
11 within said gas chamber and includes a fluid tube
12 having a fluid tube diameter and a fluid tip having
13 a fluid tip diameter substantially equal to or less
14 than the fluid tube diameter.

15

16 10. The apparatus of Claim 9, wherein said fluid
17 tube has a tapered throat portion located in said
18 gas chamber, the throat portion having a throat
19 portion diameter which is less than the fluid tube
20 diameter.

21

22 11. An apparatus for spraying liquid surface
23 treatment material, the apparatus comprising:
24 a housing;
25 a liquid inlet for supply of the liquid surface
26 treatment material;
27 a gas inlet for supply of pressurized gas to be
28 mixed with the liquid surface treatment material;
29 an outlet nozzle through which the gas and
30 liquid surface treatment is sprayed;

1 a control needle valve adapted to regulate the
2 supply of the liquid surface treatment material to
3 the outlet nozzle;

4 a gas supply passageway connecting said gas
5 inlet to said outlet nozzle; and

6 a control means for controlling the control
7 needle valve, the control means comprising a cap
8 member received on said housing and engaged with
9 said control needle valve, the cap member being
10 adapted so as to be adjustable in the axial
11 direction relative to the housing to limit axial
12 movement of the control needle valve.

13
14 12. The apparatus of Claim 11, wherein said cap
15 member and housing are provided with calibrations
16 which indicate the amount of axial adjustment of the
17 needle valve.

18
19 13. The apparatus of either Claim 11 or Claim 12,
20 further comprising a gas valve operable between an
21 open position and a closed position.

22
23 14. The apparatus of Claim 13, wherein the gas
24 valve is located in the gas supply passageway.

25
26 15. The apparatus of either Claim 13 or Claim 14,
27 further comprising a trigger means adapted to
28 operate both said control needle valve and gas
29 valve.

30

1 16. The apparatus of either Claim 13 or Claim 14,
2 wherein said control needle valve and gas valve are
3 remotely operated.
4

5 17. The apparatus of Claim 16, wherein the control
6 needle valve is remotely operated by way of
7 pressurised gas.
8

9 18. The apparatus of Claim 17, further comprising a
10 piston chamber and a piston located in the piston
11 chamber, the piston adapted to engage said needle
12 control valve when actuated by said pressurised gas.
13

14 19. The apparatus of Claim 18, further comprising a
15 bore connecting the gas supply passageway and the
16 piston chamber, such that pressurised gas may pass
17 through the bore to the piston chamber when the gas
18 valve is in the open position.

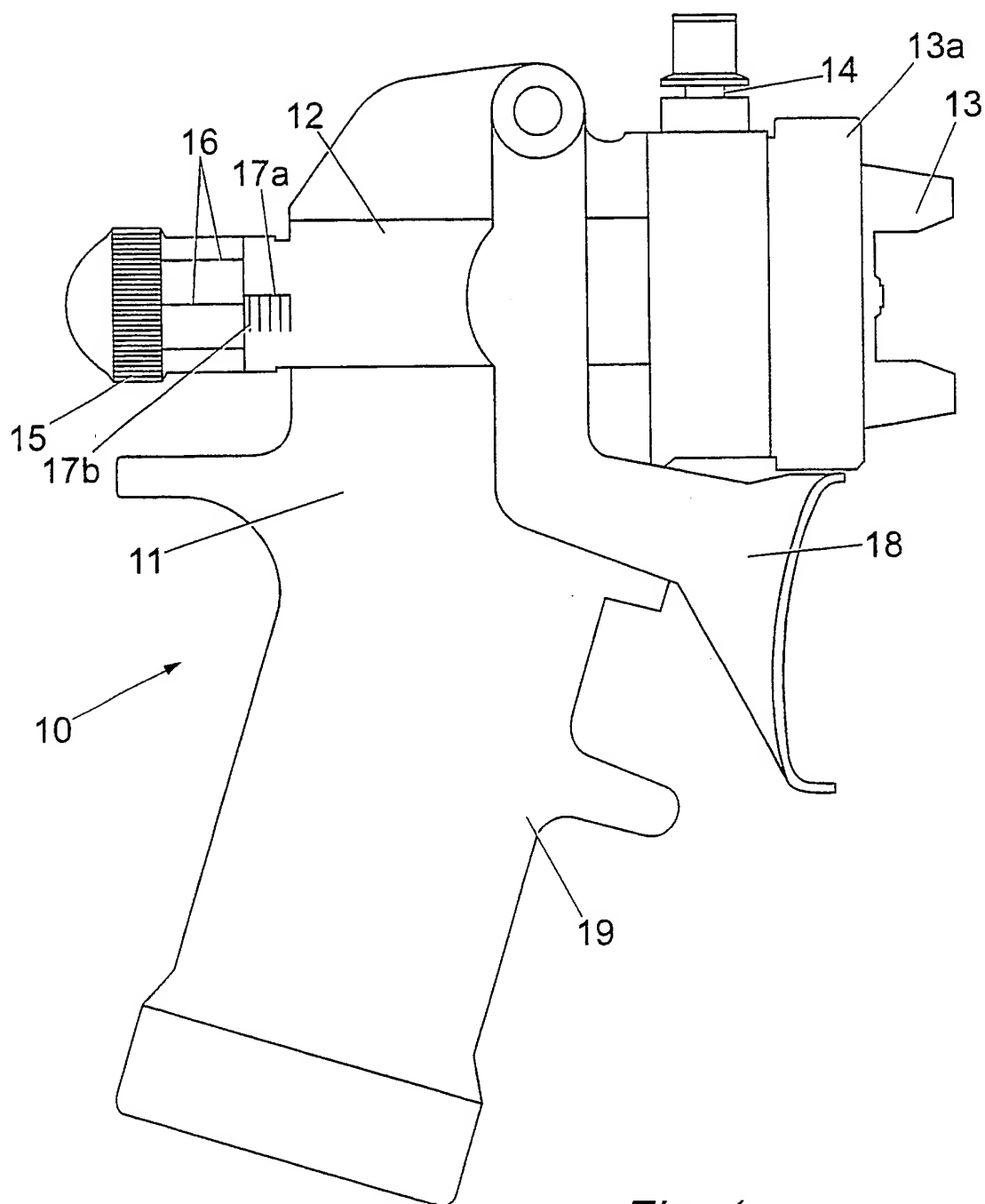
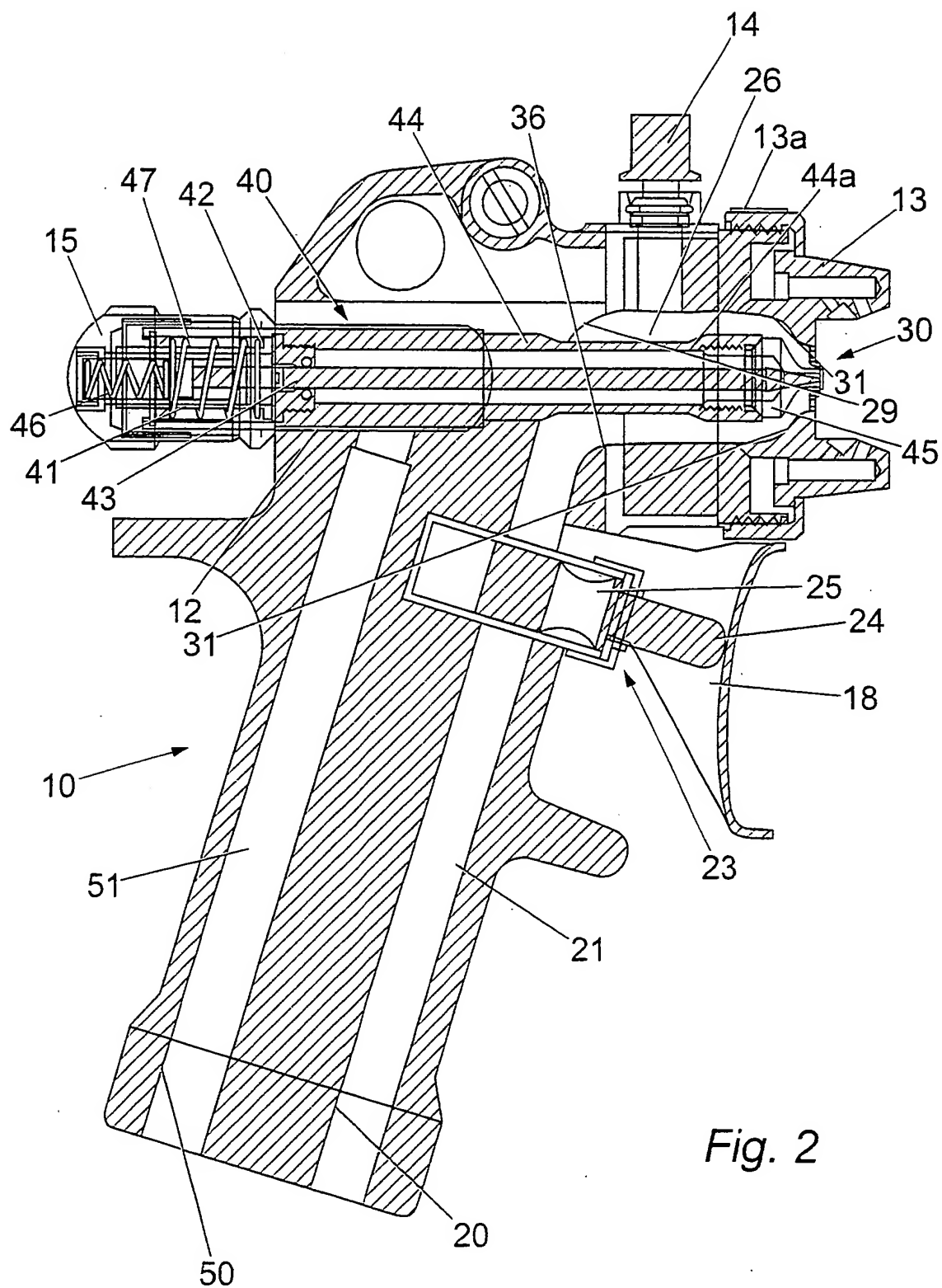


Fig. 1

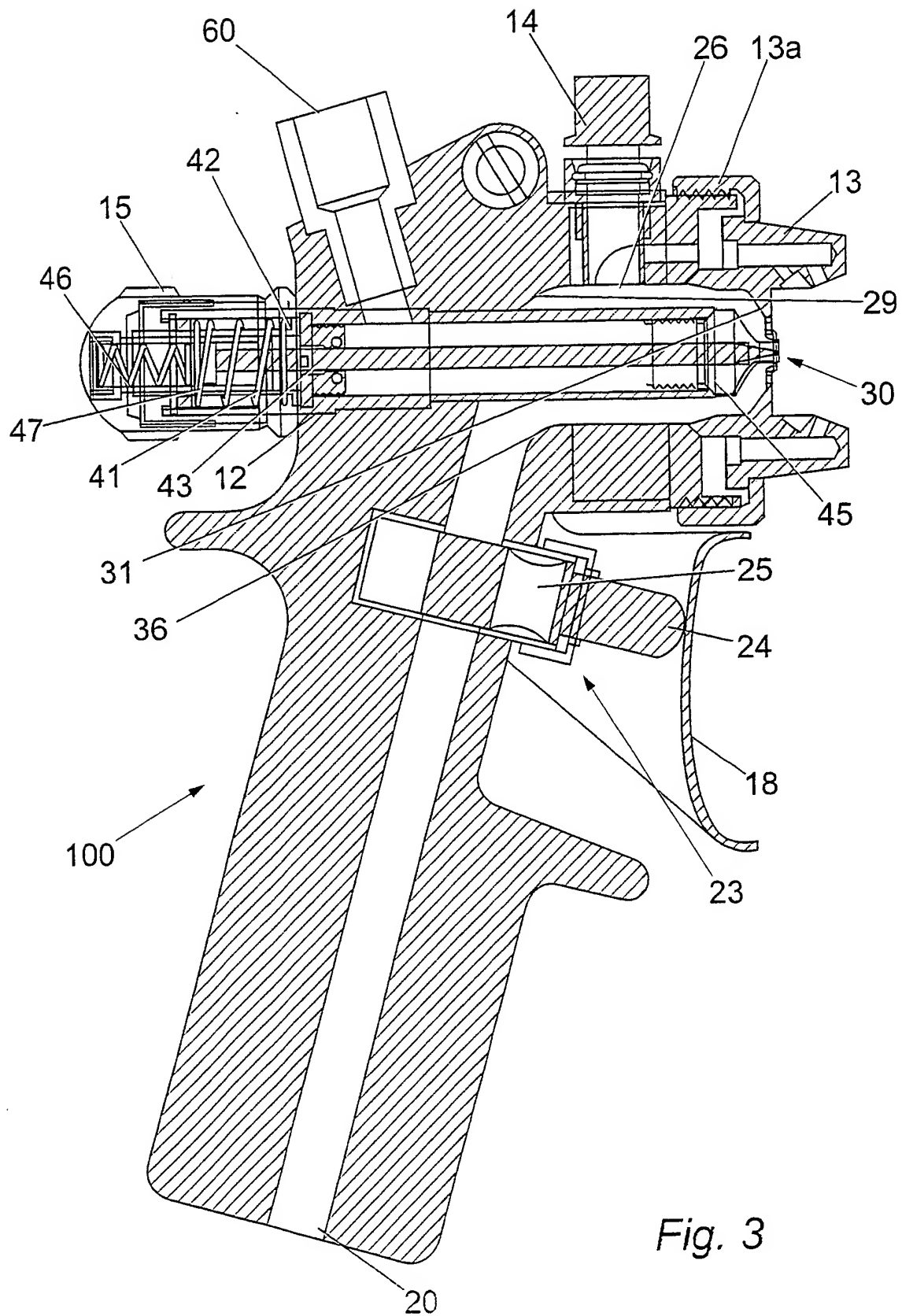
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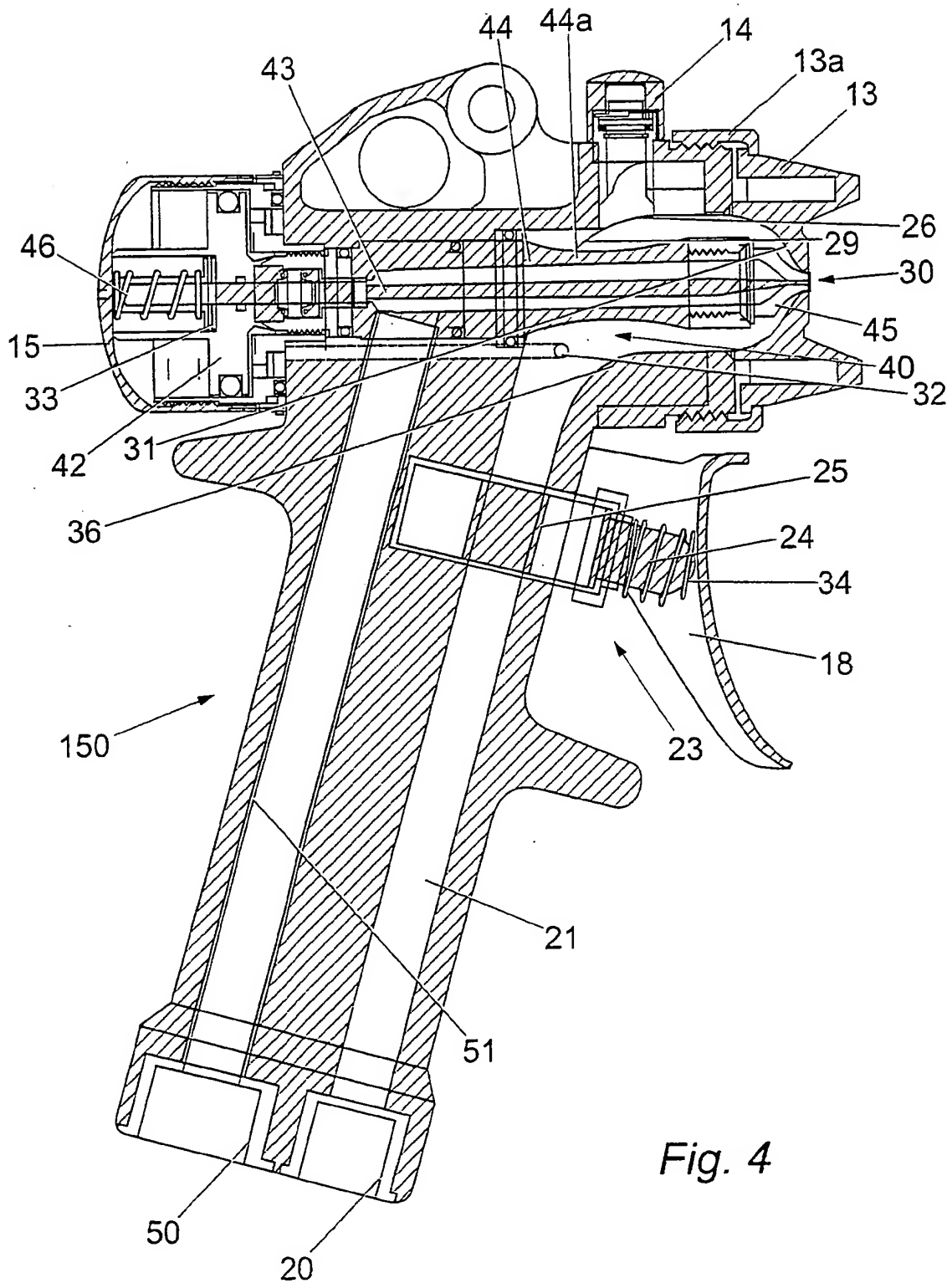


Fig. 4

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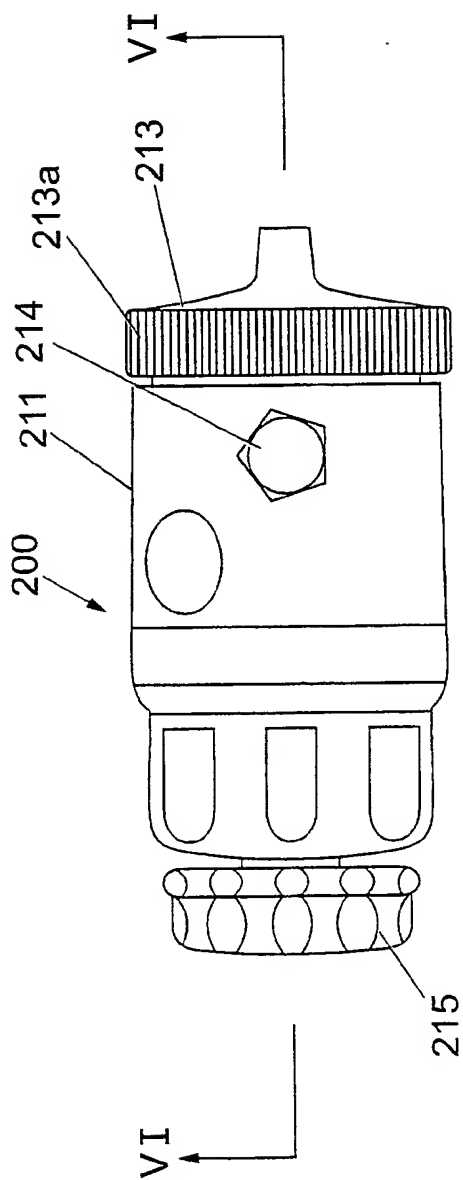


Fig. 5a

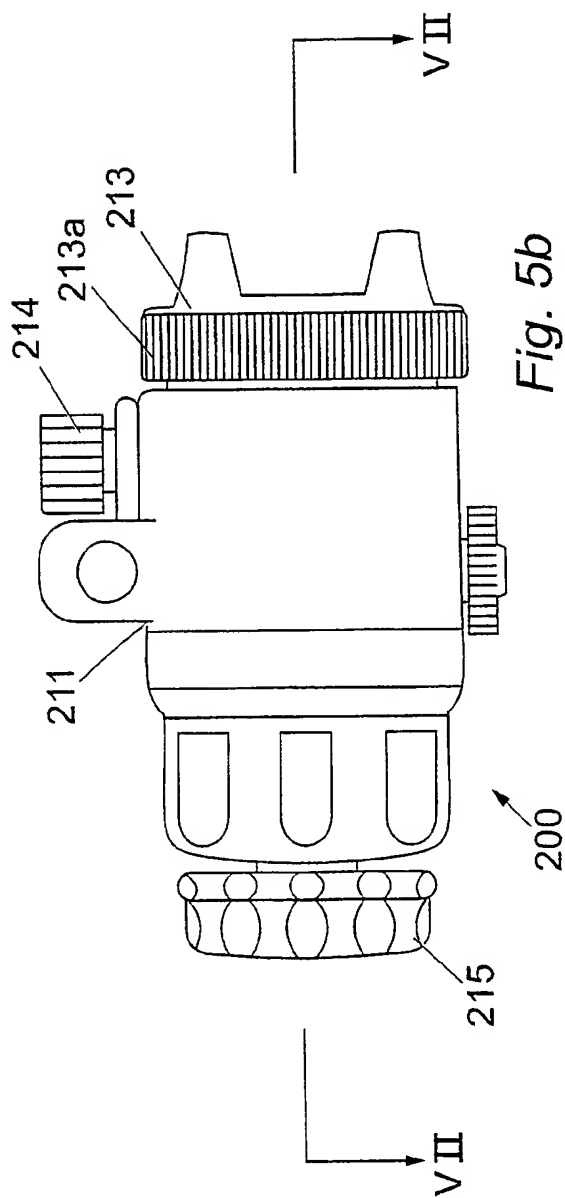


Fig. 5b

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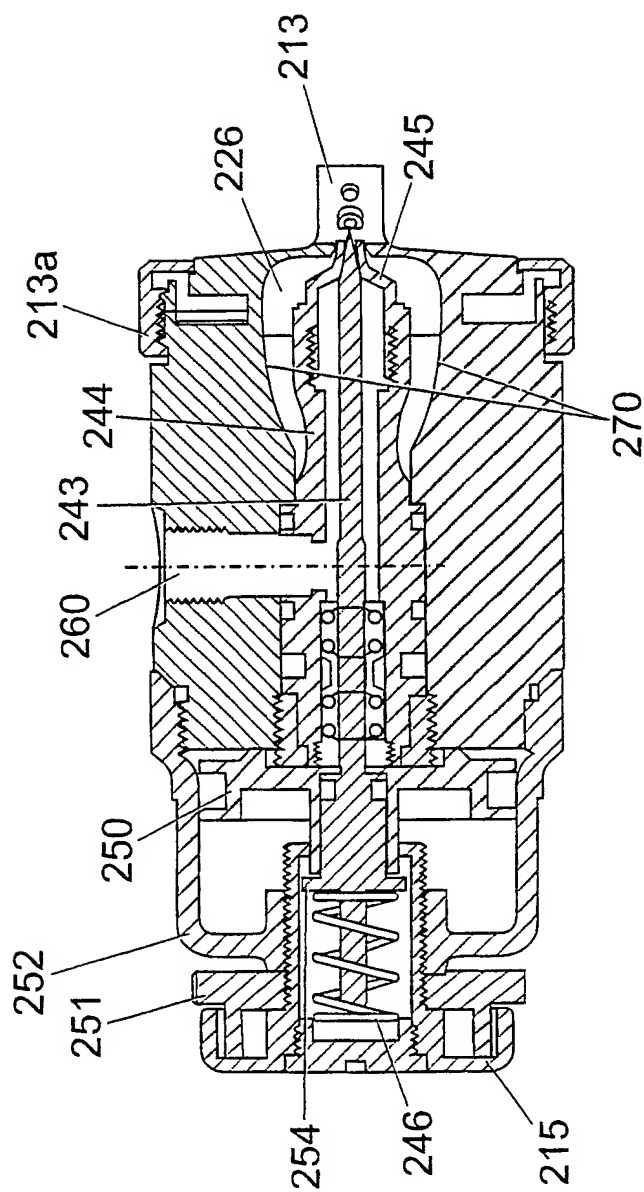
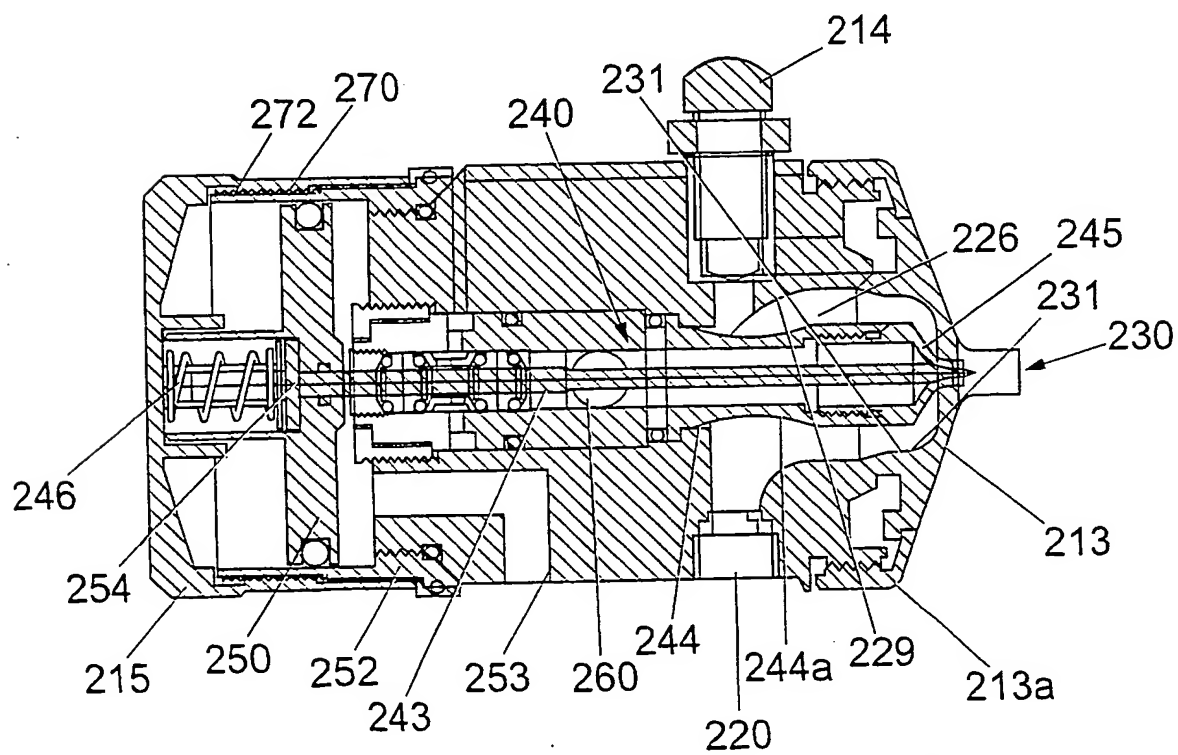
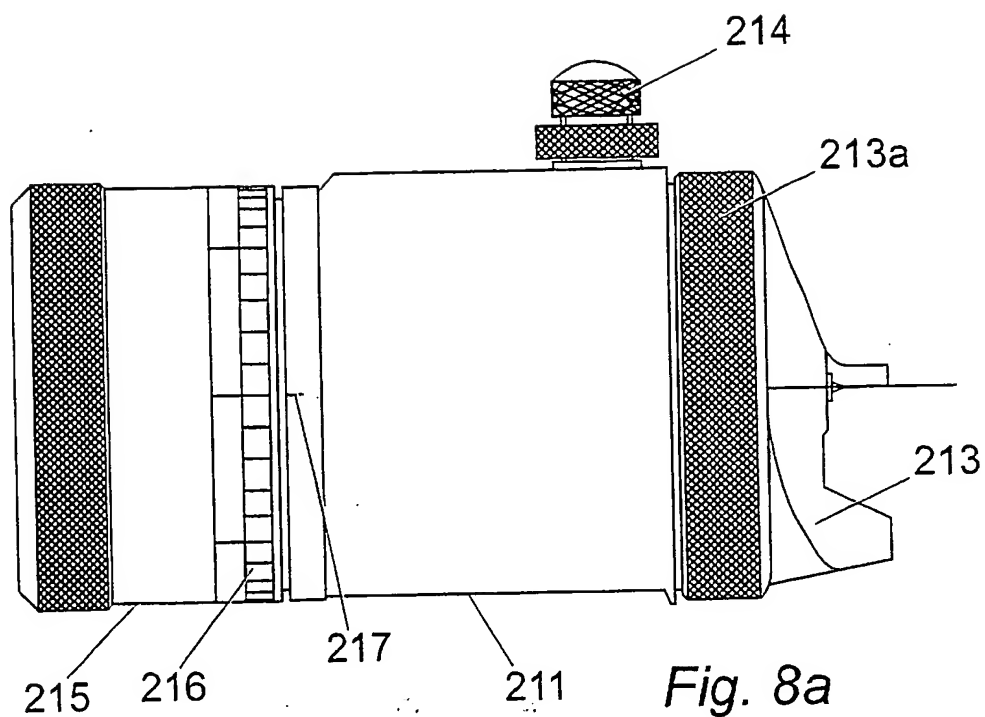


Fig. 7

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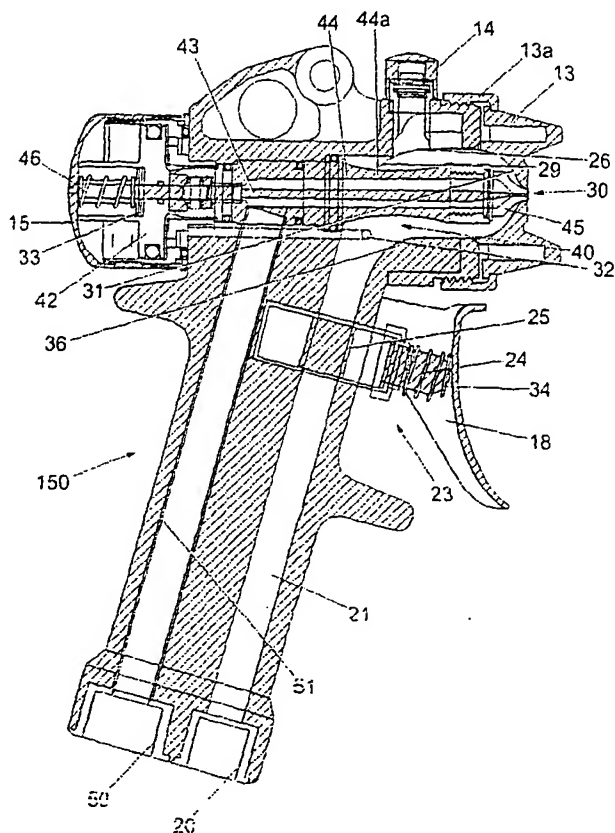
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[Continued on next page]

(54) Title: **SPRAY GUN**



(57) Abstract: A spraying apparatus (10) for spraying liquid surface treatment material comprises a gas inlet (20), a liquid inlet (50) and an outlet nozzle (30). The apparatus (10) also comprises a needle valve (40) for regulating the supply of surface treatment material to the nozzle (30). The needle valve (40) is at least partially located within a gas outlet chamber (26) and is adapted so as to cause minimal disruption to the gas flow from the gas inlet (20) to the nozzle (30). To further aid gas flow efficiency, the gas supply passage (21) is substantially straight, the outlet chamber (26) has a laterally outwardly tapering inlet and an inwardly tapering outlet (27), and a smooth radius of curvature (29) from the gas supply passage (21) into the outlet chamber (26). There is also provided a control means for controlling the axial movement of the needle valve (40), the control means being provided with indicator means so as to provide an accurate, repeatable control means.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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INTERNATIONAL SEARCH REPORT

International Application No

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A. CLASSIFICATION OF SUBJECT MATTER

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 857 511 A (GOVINDAN T) 31 December 1974 (1974-12-31) column 3, line 34 - line 64; figure 1 ---	1,2,5-10
X	DE 201 950 C (EMIL KÄUBLER) 18 May 1907 (1907-05-18) page 1, line 19 - line 42; figure ---	1,2,5-10
X	DE 209 899 C (W. GRAAF & CO. GMBH) page 1, line 16 - line 39; figure ---	1,6,8-10
X	DE 212 459 C (MINIMAX CONSOLIDATED LIMITED) 30 October 1907 (1907-10-30) page 1, line 26 - line 55; figures ---	1,6-10
X	FR 1 072 691 A (LEPETIT XAVIER) 15 September 1954 (1954-09-15) column 2, line 22 - line 53; figures ---	1,6,8-10
	--- -/--	



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

14 May 2003

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 02/04192

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 485 954 A (WACKERMANN GUY) 8 January 1982 (1982-01-08) page 3, line 5 - line 12; figure 1 ---	2, 3
A	US 2 255 189 A (SNOW ROBINSON VICTOR ET AL) 9 September 1941 (1941-09-09) page 2, line 57 - line 66 page 2, line 58 - line 75; figures 4,5 ---	2-5
A	US 1 490 238 A (SULLIVAN DANIEL J) 15 April 1924 (1924-04-15) page 1, line 41 - line 45; figures -----	7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 02/04192

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; It is covered by claims Nos.:

1-10

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-10

An apparatus for spraying liquid surface treatment material, the apparatus comprising:

- a liquid inlet for supply of the liquid surface treatment material;
- a gas inlet for supply of pressurized gas to be mixed with the liquid surface treatment material;
- an outlet nozzle through which the gas and liquid surface treatment is sprayed;
- a control needle valve arranged for axial movement on a first axis and adapted so regulate the supply of the liquid surface treatment material to the outlet nozzle;
- a gas valve operable between an open position and a closed position;
- a gas chamber communicating with said outlet nozzle and arranged to co-axially surround the control needle valve;
- and a gas supply passageway having first and second portions with first and second diameters, respectively, the first portion connecting said gas inlet and said gas valve and the second portion connecting said gas valve and said gas chamber;

wherein the first and second portions of the gas supply passageway are coaxial and the first and second diameters are substantially equal such that the gas supply passageway has substantially the same diameter over its entire length.

2. Claims: 11-19

An apparatus for spraying liquid surface treatment material, the apparatus comprising:

- a housing;
- a liquid inlet for supply of the liquid surface treatment material;
- a gas inlet for supply of pressurized gas to be mixed with the liquid surface treatment material;
- an outlet nozzle through which the gas and liquid surface treatment is sprayed;
- a control needle valve adapted to regulate the supply of the liquid surface treatment material to the outlet nozzle;
- a gas supply passageway connecting said gas inlet to said outlet nozzle; and
- a control means for controlling the control needle valve, the control means comprising a cap member received on said housing and engaged with said control needle valve, the cap member being adapted so as to be adjustable in the axial direction relative to the housing to limit axial movement of the control needle valve.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No
PCT/GB 02/04192

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3857511	A	31-12-1974	NONE	
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US 1490238	A	15-04-1924	NONE	

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